USNO Almanac Products

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What is an Almanac?

U.S. Naval Observatory

- A publication containing astronomical data arranged according to date, usually for a given year.
- Provides observable characteristics of bodies
  - Position, brightness, phenomena, etc.
- Based on fundamental reference data
  - Star catalogs
  - Solar system ephemerides
  - Adopted constants

What is an Almanac? (con't.)

- Traditionally, a paper publication
- Today, almanac data is available from USNO via...
  - Paper publications*
  - Executable software
  - Source code software
  - Web-based services
- Data, precision, and format tailored for specific applications

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* co-published with H.M. Nautical Almanac Office, United Kingdom

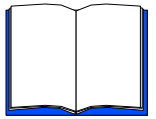
Applications

- Celestial navigation
- “High precision”
  - Telescope / sensor pointing
  - Scientific research
- Special purposes
  - Ground illumination
    - Mission planning & scheduling
    - NVG use
- General use
  - Litigation, accident reconstruction, photography, architecture, etc.

Almanac Products for Celestial Navigation

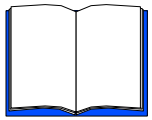
U.S. Naval Observatory

- *The Nautical Almanac*
  - For marine navigation
  - Required by Navy policy and U.S. law



- STELLA
  - For marine navigation
  - Includes full sight planning and reduction tools
  - U.S. DoD only

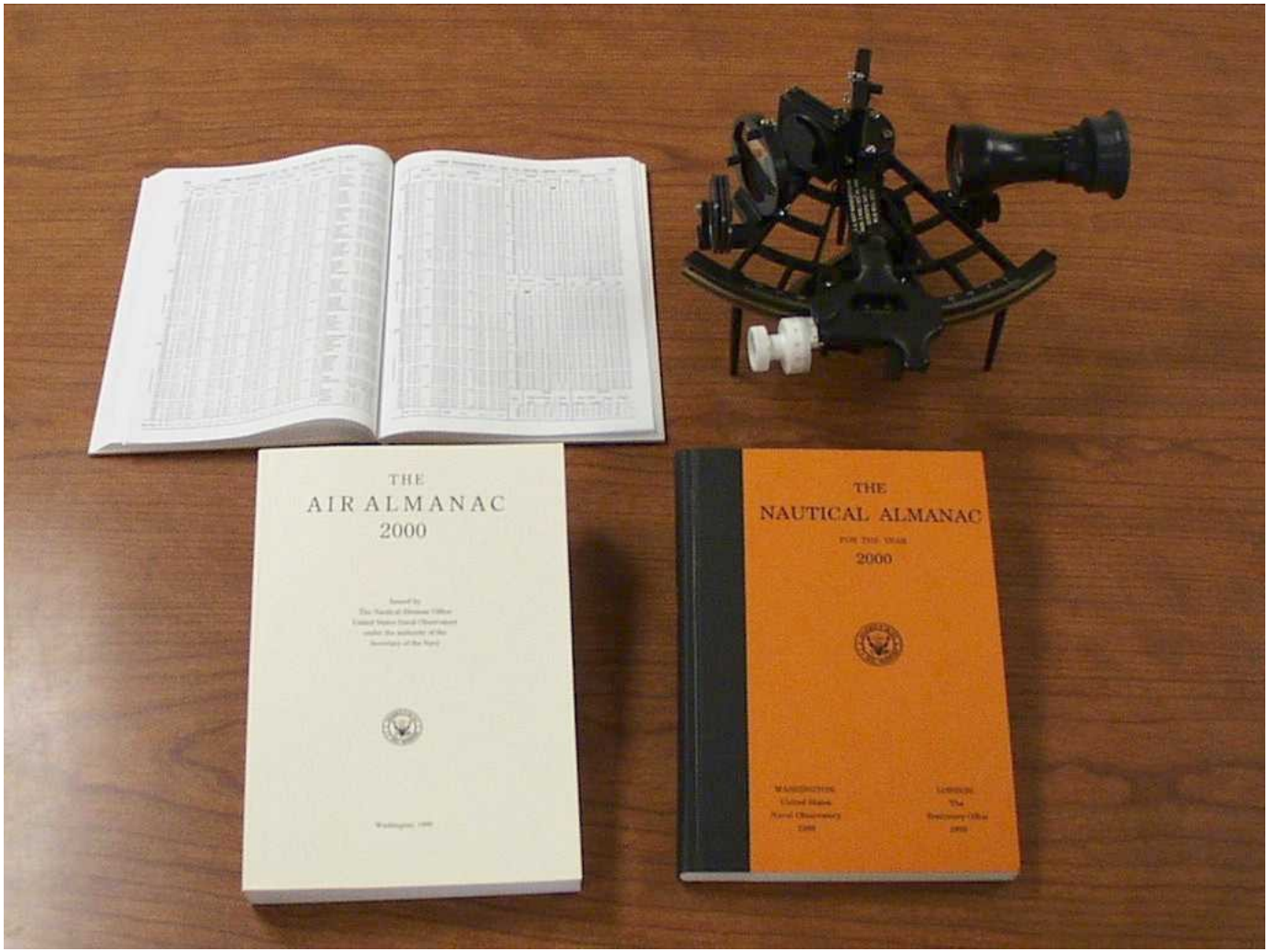
- *The Air Almanac* (U.S. version)
  - For air navigation



- Web services

The Air & Nautical Almanacs

U.S. Naval Observatory



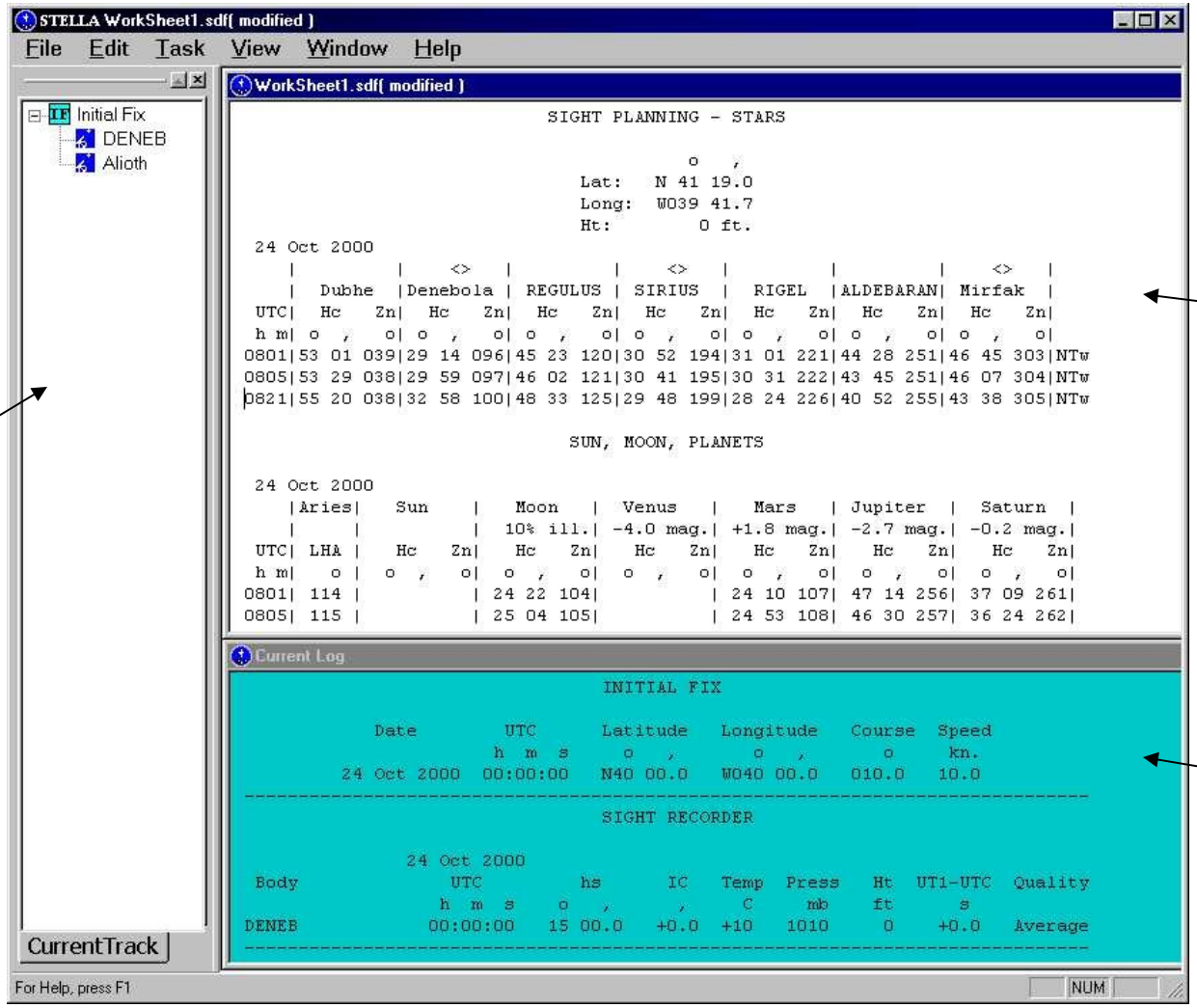
STELLA Overview

U.S. Naval Observatory

- PC-based application
  - Version 2.0 (1970-2010)
- Response to formal U.S. Navy requirement
- Provides standard means for performing cel nav computations
  - Almanac
  - Position update
  - Rise/set/transit/twilight (fixed site and moving platform)
  - Gyro/compass error (planning and computation)
  - Sight planning (table and graphic)
  - Sight reduction (with sight recorder)
  - Log

STELLA User Interface

U.S. Naval Observatory


STELLA WorkSheet1.sdf(modified)
File Edit Task View Window Help
Initial Fix
DENEB
Alioth
CurrentTrack
WorkSheet1.sdf(modified)
SIGHT PLANNING - STARS
o ,
Lat: N 41 19.0
Long: W039 41.7
Ht: 0 ft.
24 Oct 2000
| Dubhe | Denebola | REGULUS | SIRIUS | RIGEL | ALDEBARAN | Mirfak |
UTC| Hc Zn| Hc Zn| Hc Zn| Hc Zn| Hc Zn| Hc Zn| Hc Zn|
h m| o , o| o , o| o , o| o , o| o , o| o , o| o , o|
0801|53 01 039|29 14 096|45 23 120|30 52 194|31 01 221|44 28 251|46 45 303|NTw
0805|53 29 038|29 59 097|46 02 121|30 41 195|30 31 222|43 45 251|46 07 304|NTw
0821|55 20 038|32 58 100|48 33 125|29 48 199|28 24 226|40 52 255|43 38 305|NTw
SUN, MOON, PLANETS
24 Oct 2000
|Aries| Sun | Moon | Venus | Mars | Jupiter | Saturn |
| | | 10% ill.| -4.0 mag.| +1.8 mag.| -2.7 mag.| -0.2 mag.|
UTC| LHA | Hc Zn| Hc Zn| Hc Zn| Hc Zn| Hc Zn| Hc Zn|
h m| o | o , o| o , o| o , o| o , o| o , o| o , o|
0801| 114 | | 24 22 104| | 24 10 107| 47 14 256| 37 09 261|
0805| 115 | | 25 04 105| | 24 53 108| 46 30 257| 36 24 262|
Current Log
INITIAL FIX
Date UTC Latitude Longitude Course Speed
h m s o , o , o kn.
24 Oct 2000 00:00:00 N40 00.0 W040 00.0 010.0 10.0
SIGHT RECORDER
24 Oct 2000
Body UTC hs IC Temp Press Ht UT1-UTC Quality
h m s o , , C mb ft s
DENEB 00:00:00 15 00.0 +0.0 +10 1010 0 +0.0 Average
For Help, press F1
NUM

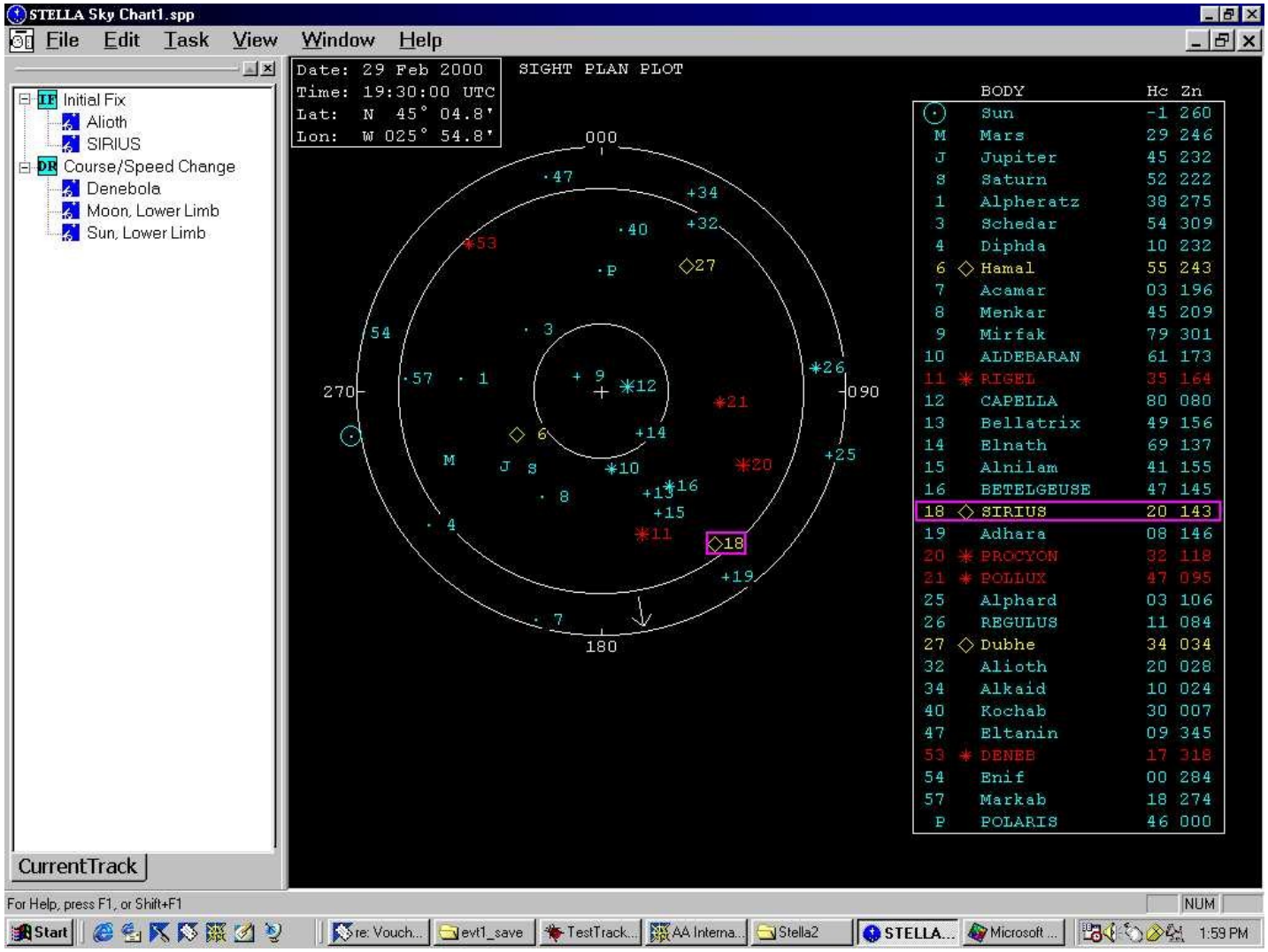
Current Track

Worksheet

Log

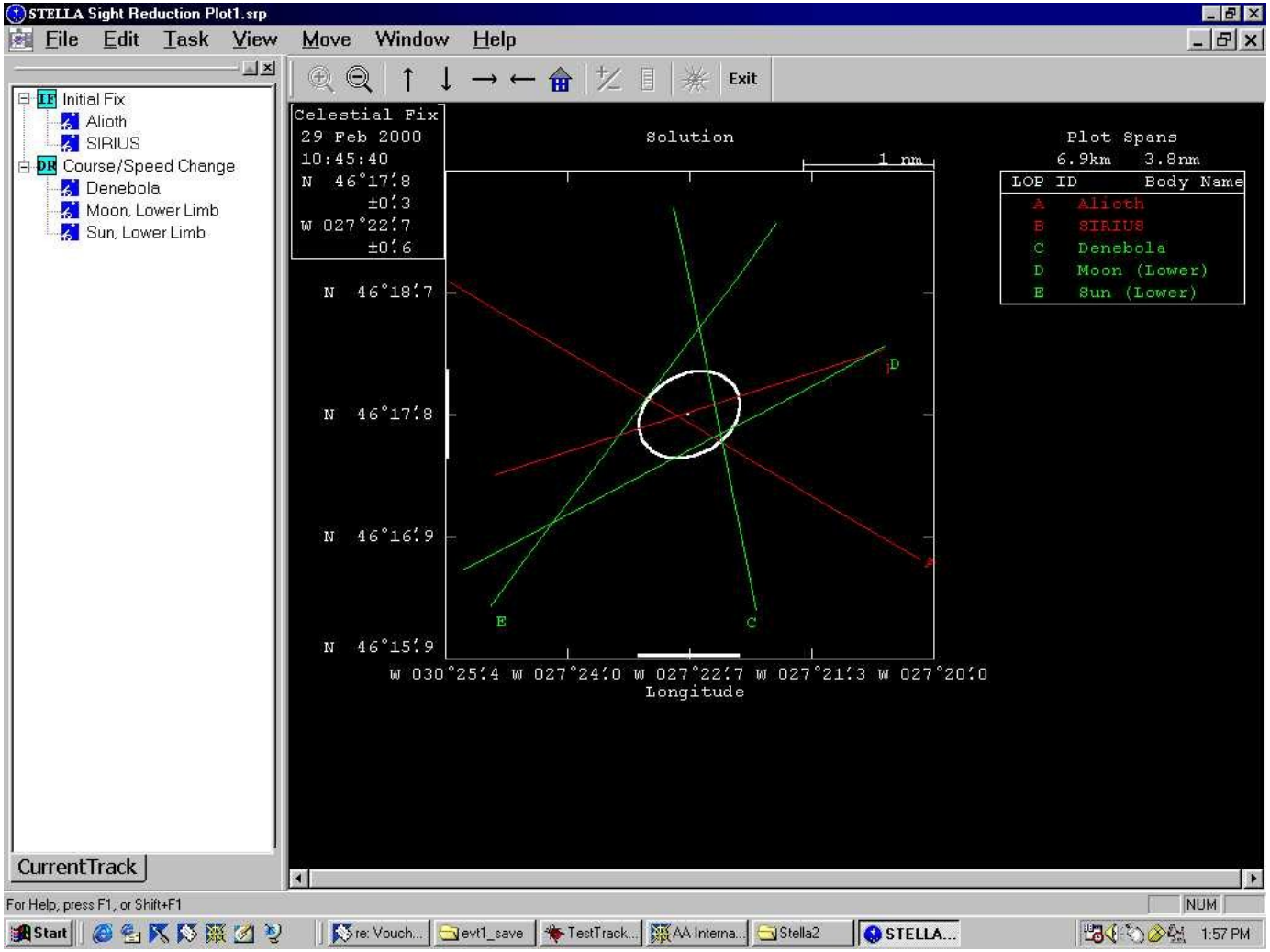
STELLA (Sight Planning)

U.S. Naval Observatory



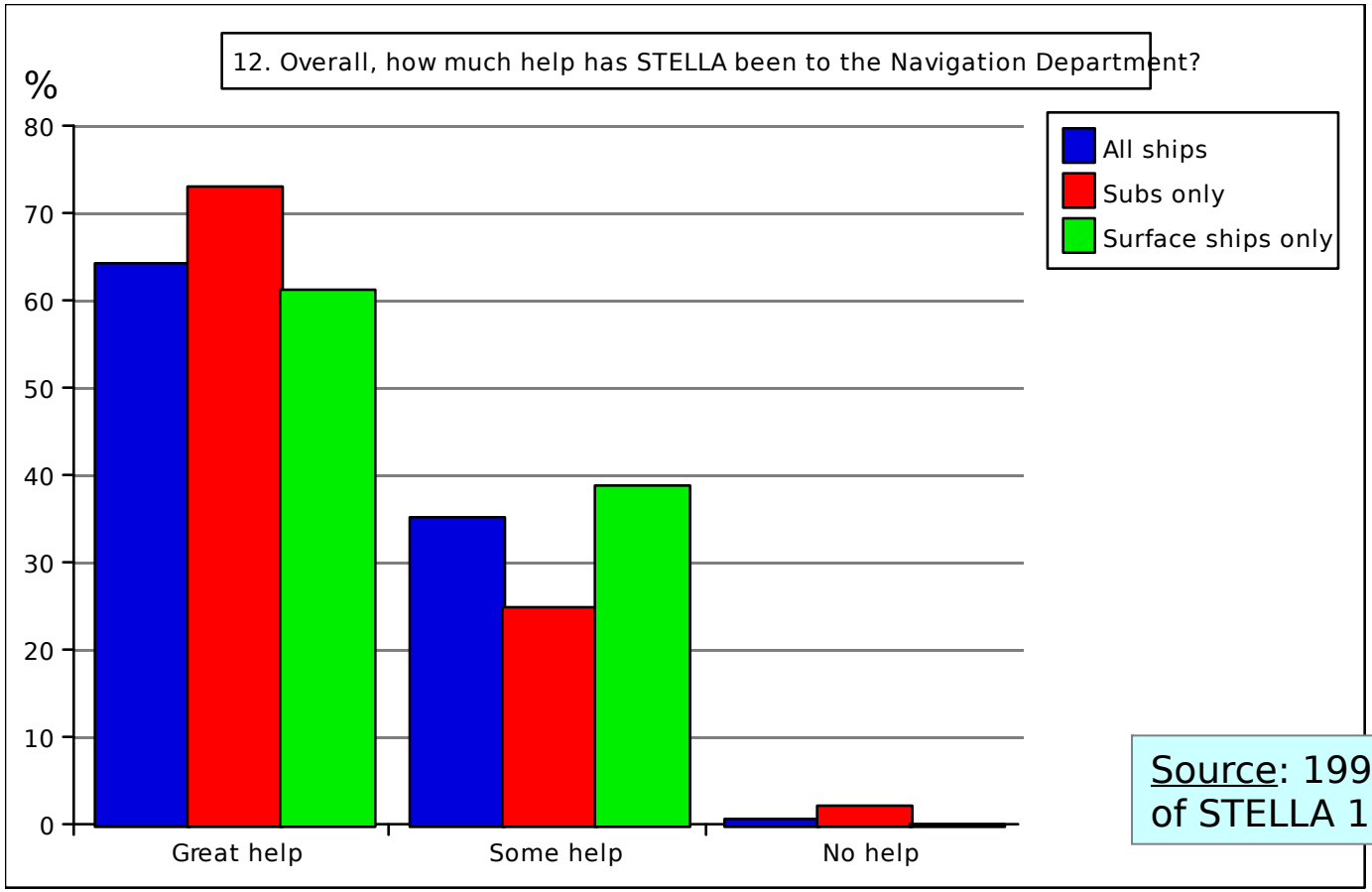
STELLA (Sight Reduction)

U.S. Naval Observatory



Impact of STELLA

U.S. Naval Observatory

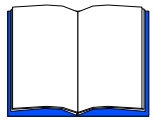


Source: 1997 Survey of STELLA 1.0 Users

Almanac Products for High-Precision Applications

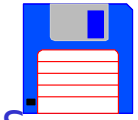
U.S. Naval Observatory

- *The Astronomical Almanac*



- MICA
  - Computer-based counterpart of *Astron. Alm.*
  - PC and Macintosh editions

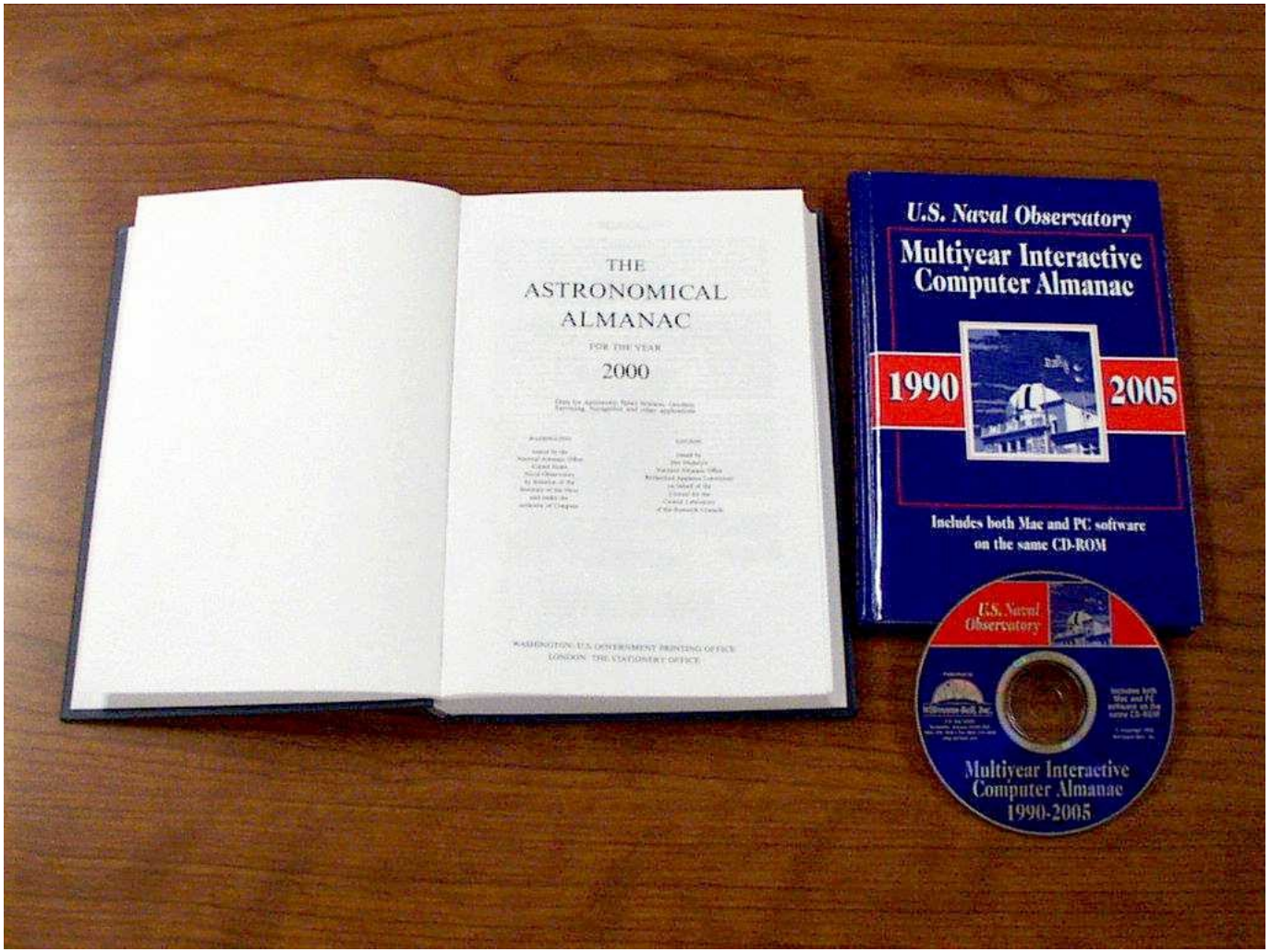
- NOVAS
  - Source code (Fortran and C)
  - Common astrometric quantities & transformations



- Web services
  - WebMICA

The Astronomical Almanac & MICA

U.S. Naval Observatory



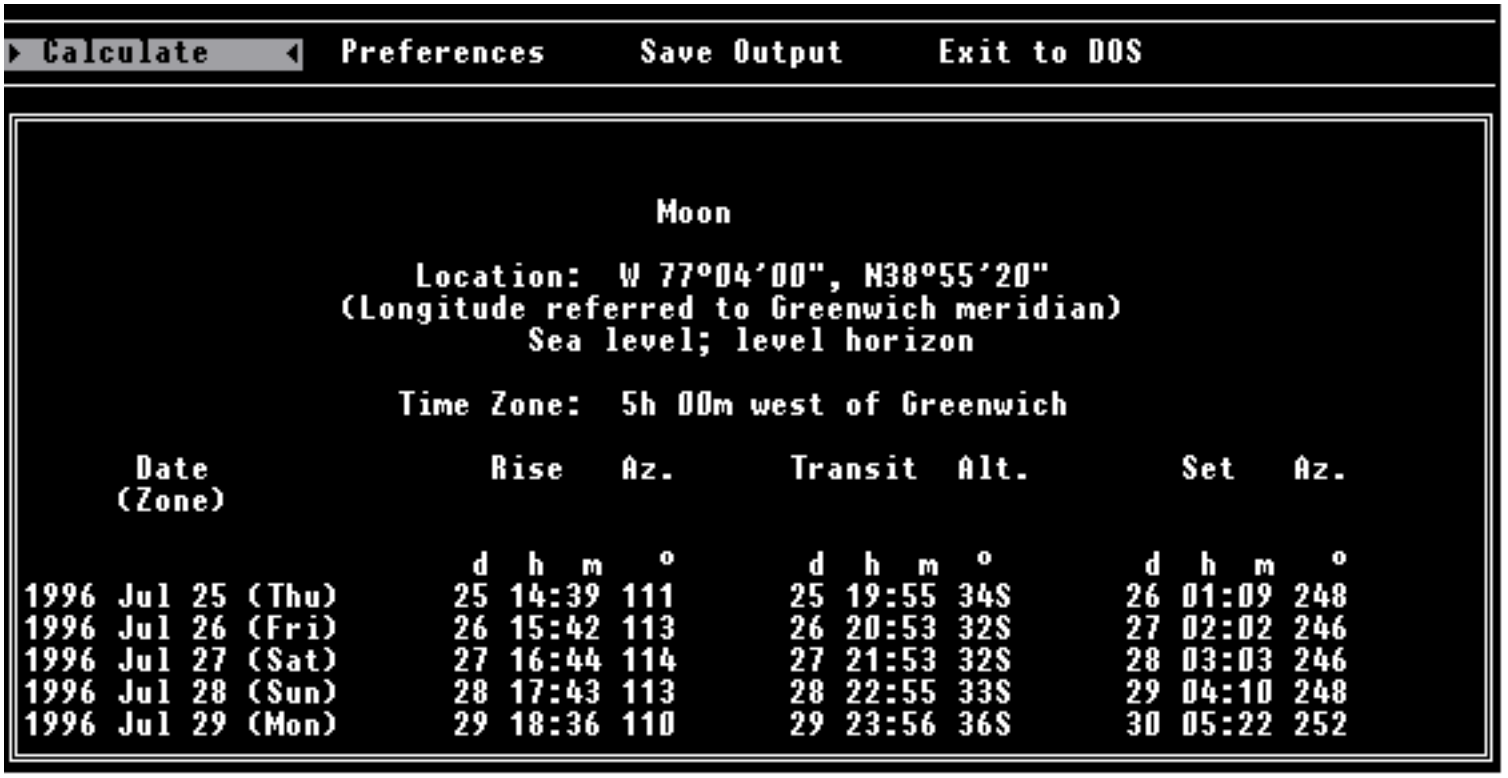
MICA Overview

U.S. Naval Observatory

- USNO's second-generation computer almanac
- Complements the *Astronomical Almanac*
  - Geocentric *and* topocentric data
  - TT *and* UT
  - Long interval: 1990-2005 (Version 1.5)
- Provides
  - Nine positions types
  - Sidereal time, nutation & obliquity, calendar
  - Rise/set/transit/twilight
  - Physical ephemerides
  - Configuration

MICA (DOS User Interface)

U.S. Naval Observatory


▸ Calculate ◂ Preferences Save Output Exit to DOS
Moon
Location: W 77°04'00", N38°55'20"
(Longitude referred to Greenwich meridian)
Sea level; level horizon
Time Zone: 5h 00m west of Greenwich
Date (Zone) Rise Az. Transit Alt. Set Az.
d h m ° d h m ° d h m °
1996 Jul 25 (Thu) 25 14:39 111 25 19:55 34S 26 01:09 248
1996 Jul 26 (Fri) 26 15:42 113 26 20:53 32S 27 02:02 246
1996 Jul 27 (Sat) 27 16:44 114 27 21:53 32S 28 03:03 246
1996 Jul 28 (Sun) 28 17:43 113 28 22:55 33S 29 04:10 248
1996 Jul 29 (Mon) 29 18:36 110 29 23:56 36S 30 05:22 252

NOVAS

U.S. Naval Observatory

- Source code library
  - C & Fortran
- Common astrometric quantities and transformations
  - Precession, nutation, sidereal time, etc.
  - PNSW transformation
  - Apparent, topocentric, astrometric places
- Rigorous and precise
  - Consistent with IAU resolutions
- Current version: 2.0
  - ICRS-compatible

Almanac Products for Special Purposes

U.S. Naval Observatory

- Solar Lunar Almanac Core (SLAC)
  - Specialized almanac “engine”
  - C source code
  - Sun/Moon phenomena + illumination
  - U.S. DoD-only

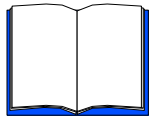
- Custom solutions
  - Mainly for U.S. DoD
  - Software
  - Data

- Web services
  - Example:illumination data based on SLAC

Products for General Use

U.S. Naval Observatory

- *Astronomical Phenomena*
  - Preprint of selected data from the *Astron. Alm.*



- Web Site
  - Wide variety of information
    - Product information
    - Interactive data services
    - Answers to FAQ
  - 7000-10000 user sessions per day
  - DoD-only services

AA Web Site

U.S. Naval Observatory

Data Services
Sun and Moon rise and set times, Moon phases, eclipses, seasons, positions of solar system objects, and other data
Frequently Asked Questions
background information on common astronomical phenomena, calendars and time, and related topics
Publications
astronomical and navigational almanacs, special publications, research reports
Software Products
computer almanac for PCs and Macs, and more
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Plans

- Major revision of the *Astronomical Almanac*
  - Content and format
  - Incorporate ICRS and new ephemeris (DE405)
  - Web component
  - In progress
- Determine future of *Air Almanac*
  - Assess true requirements
- STELLA
  - Version 2.0 done
  - Continue to maintain and improve

Plans (con’t.)

- MICA
  - Version 2.0 in development
    - Improved user interface
    - More calculations
    - Longer interval (~200 years)
- SLAC
  - Version 2.0 in development
  - Phenomena at heights above sea level
  - Better refraction model
- Web site
  - Ongoing improvements

Summary

USNO…

- Provides a wide range of almanac products and astronomical data services
  - Printed almanacs
  - Computer-based almanacs
  - Source-code software and data
  - World Wide Web site

  that are benchmark standards used worldwide.

- Will continue to update and improve these products
  - To satisfy user requirements
  - To incorporate the best fundamental reference data